5.2.1.1 Preserving Landforms

Description

Clearing and grading changes the surface and shape of the land. Conventional approaches force the site to adapt to the owner's development program. However, existing landforms play a critical role in maintaining natural processes, particularly the movement of water across or even under a site, and should be preserved and integrated into the development program. Natural landforms can provide functional and aesthetic benefits.

Figure 5.2.1.1-1. Clearing and grading a hilltop removes the ecosystem services inherent in undisturbed soils and vegetative cover.

Minimizing the amount of earth-moving and grading on a development site can preserve existing landforms, soil, drainage patterns, and plants. These areas can be protected in three major ways:

- Identify and protect existing landforms, site vegetation, soils, and drainage patterns where possible.
- Readjust the site program and redesign the site plan to take advantage of the site's existing topography.
- Work with existing landforms in the design of buildings and circulation.

Minimizing soil compaction and disturbance by designing site program(s) (buildings, open space, parking, and circulation network) to work with the existing contours will help to maintain the hydrologic function inherent in an undisturbed site and to minimize the impact of development. Minimizing the developed land area and total land disturbance will:

- Minimize the actual stormwater generated (volume and peak flow).
- Lower discharge rates significantly (by slowing runoff and increasing onsite storage).
- Improve water quality preventively (by reducing sediment-laden runoff from eroding surfaces).
- Provide more opportunities for the most effective location of proposed BMPs.

BMP Functions Table

BMP	Applicability	Volume Reduction	Water Quality	Peak Rate Reduction	Recharge	Runoff Temperature Mitigation	Heat Island	Habitat Creation	Maintenance Burden	Cost
Preserving Landforms	U/S/R	H	H	H	H	M	M	H	L	L

KEY: U = Urban; S = Suburban; R = Rural; H = High; M = Medium; L = Low

Key Design Guidelines

- Identify areas that may require extensive grading and/or earth moving early in the design process.
- Rework initial building program to better "fit" the capacity of the site.
- Redesign major site components to better "fit" the unaltered terrain.
- Reduce impervious footprints where possible *(*see Section 5.3.1, Pervious Pavement, in this manual).
- Reduce grading by integrating buildings, roads, parking, and stormwater management facilities into the terrain (e.g., use the building as a retaining wall or as multilevel access on steep sites, or use flat roofs as extensions of circulation system or open space).

Advantages

- Costs may be reduced by:
  - Preserving existing topography and healthy soils and vegetation.
  - Reducing volume and velocity of site stormwater, minimizing the need for extensive stormwater management facilities.
  - Reducing proposed grading, which minimizes labor and construction machinery costs.
  - Reducing or eliminating the need for retaining walls.
- Undisturbed soils offer the following advantages:
  - Minimize stormwater runoff by maximizing water-holding and infiltration capacity of site vegetation and soils.
  - Can effectively store and cycle nutrients.
  - Sequester carbon as organic matter.

Disadvantages

- Requires greater collaboration between design teams and contractors.
- New approaches to grading can take time to adopt and can meet natural resistance to change.
- Construction staging areas and traffic routes may be tighter.
- Imaginative solutions are required to achieve potential cost savings and programmatic objectives.

Applications

Any site where there are significant topographic changes or distinctive resources (such as rock outcroppings, mature woodlands, wetlands) to be preserved.

Figure 5.2.1.1-2. Using existing topography to create an outdoor amenity.

Design Considerations

Site Analysis:

- Use the contours from the site survey to analyze (with a quick site diagram) the existing landforms, e.g., ridge, hill, valley bottom, valley sides etc.
- Identify areas of extreme/abrupt topographic change.
- Distinguish between manmade topographic changes and natural forms. Historic changes may or may not be worth keeping.
- Identify existing flow patterns for sub-watersheds onsite, including where water presently drains and whether water sheet flows across the site and/or concentrates in channels. Some stormwater solutions may require an understanding of offsite stormwater discharges beyond the property boundaries.

Figure 5.2.1.1-3. Design road alignments with topography.

Figure 5.2.1.1-4. Bridges over valleys to facilitate access.

Design Strategies:

- Identify significant topographic changes or distinctive resources (such as rock outcroppings) and design to safeguard these areas by including them in a "Protected Area" or "Area of Minimal Disturbance" (see Section 5.2.1, Protect Undisturbed and Healthy Soils, in this manual).
- Review site plans to determine whether proposed earth-moving or site grading is necessary to achieve the program or whether land disturbance can be minimized through redesign or plan modifications. Consider adjustment of the location and layout of buildings and roads to minimize proposed site grading, removal of existing vegetation (clearing and grubbing), and soil removal or compaction. Allowing the building or site program to "fit" the topography, as opposed to shaping the topography to "fit" the program, can create a more attractive site with greater site amenities and fewer stormwater management measures needed.
- Design strategies to achieve reduced disturbance include:
  - Using cluster design and concentrating uses, encouraging greater amounts of open space.
  - Integrating multiple functions for site facilities, such as a complete street that combines traffic and stormwater management.
  - Using bridges rather than cutting or filling to navigate steep slopes.
  - Integrating buildings into steep slopes (as bridges, retaining walls, etc.).
  - Eliminating hard edge engineering grading where the built project meets the landscape.
  - Encouraging plans that preserve surface irregularities beyond the building project landscape. These irregularities contribute to slowing and infiltrating stormwater.

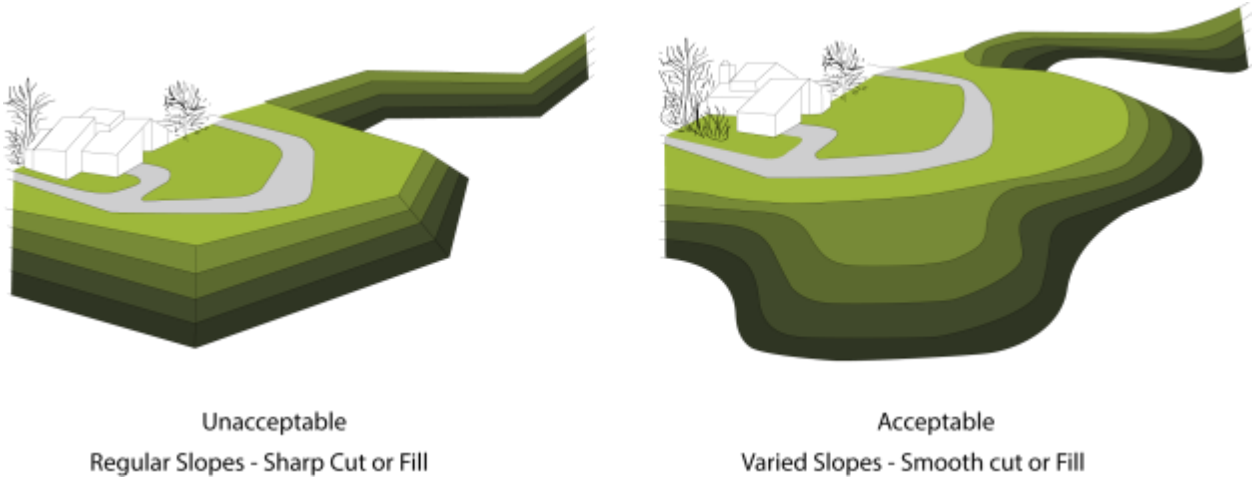

Figure 5.2.1.1-5. Grading example; regular vs. varied slopes.

- Limiting grading, where possible, to preserve site landforms. If this approach is not feasible, grade to **modify but not obliterate the landforms.** Additional grading can mimic, formalize or dramatize typical landforms, e.g., grade long slopes in "terraced" benches to hold runoff and prevent erosion.
- Avoiding abrupt changes where new grades meet existing grades. These areas can erode or gather debris and sediment later.
- Where possible, allowing roads and pedestrian circulation to follow existing contours (always adjusting grades and alignments to comply with safety requirements) and avoiding crossing and/or fragmenting sensitive site habitats and features.

Figure 5.2.1.1-6. Example of abrupt transition between new and existing grade

Construction Strategies:

- Minimize construction traffic routes, both in width and length.
  - Identify designated routes with signs and fencing, and provide emergency pull-offs where necessary.
  - Enforce traffic requirements to remain within fenced areas.
- Locate both traffic routes and building footprints on already disturbed areas, where possible.
- Distribute stockpiles and storage into smaller, more flexible areas.
- Reduce construction areas needed to construct individual facilities where possible.
- Sheet and shore areas to temporarily support the sides of excavations. This will allow for a reduction in the size of the excavation area and a reduction in the amount of grading required to construct surface elements.
- Minimize disturbance adjacent to sensitive/fragile protected areas. Leave a buffer (open space, construction barrier, or vegetative buffer) between development and protected areas.

Construction Sequencing

- Fence off "Protected" and "Minimal Disturbance" areas with approved durable fencing as identified on the Site Protection Plan.
- Areas designated as "Protected" or "Minimal Disturbance" must also be protected from sediment and stormwater loads from disturbed, upgradient parts of the site, as well as from construction traffic.
- Protection measures for areas designated as "Protected" or "Minimal Disturbance" must be strictly enforced. For example, if knocked down, fencing must be immediately set up again; if broken, fencing must be immediately repaired.

Operations and Maintenance

Sites with minimized earth-moving and grading during site construction typically require less maintenance; however, regular monitoring is required after project completion:

- Regraded terrain requires monitoring of surface water flow to ensure that slope integrity is maintained.
- Locations where new grades meet existing grades also require monitoring to ensure that these areas do not erode or collect sediment and debris.
- Monitor health of vegetation on steep slopes. Irrigation may be required to establish new vegetation. Plants that are dying should be replaced with stronger, more aggressive species.

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5.2.1.1 Preserving Landforms Criteria Checklist

ITEM DESCRIPTION	YES	N/A
The following checklist provides a summary of design guidance by the owner/applicant for successful implementation.		
• Significant topographic changes or distinctive resources (such as rock outcroppings) identified and included in a "Protected Area" or "Area of Minimal Disturbance." Provide photo documentation. • Distinguish between manmade topographic changes and natural forms (manmade need not be saved).	☐ ☐	☐ ☐
• Site plans reviewed to determine whether proposed earth-moving or site grading is necessary to achieve the program or whether land disturbance can be minimized through redesign or plan modifications. • Major site components arranged to better "fit" the unaltered terrain. • Cluster design employed or uses concentrated (e.g., integrate multiple functions for site facilities, such as a complete street that combines traffic and stormwater management).	☐ ☐ ☐	☐ ☐ ☐
• Buildings integrated into steep slopes as opposed to flattening the site to accommodate building pads.	☐	☐
• Bridges used rather than cutting or filling to navigate steep slopes.	☐	☐
• Grading plans eliminate unnatural looking, unvarying slopes as well as mathematically generated patterns of conventional grading.	☐	☐
• Grade to preserve site landforms. If this approach is not possible, grade to modify but **not** obliterate the landforms.	☐	☐
• Abrupt changes avoided where new grades meet existing grades.	☐	☐
• Roads and pedestrian circulation follow existing contours (always adjust grades and alignments to comply with safety requirements) and avoid crossing and/or fragmenting sensitive site habitats and features.	☐	☐
• Existing erosion problems have been identified and provisions for their repair are incorporated in design plans	☐	☐
• "Protected Areas" and/or "Areas of Minimal Disturbance" are safeguarded from sediment and stormwater loads.	☐	☐
• Protection, fencing details, and associated signage details for "Protected Areas" and/or "Areas of Minimal Disturbance" have been provided.	☐	☐
• Areas for site access, storage, and equipment use the smallest possible construction space, and minimize impervious surfaces, building footprints, and site disturbance.	☐	☐